

Research

*If you want to understand the mind,
then meditate.*

Buddhist monk

Exploration of the mind

Recent decades have seen an enormous increase in research on mindfulness and meditation. In the 1970s, there were only a handful of publications¹ dedicated to the science on this topic. But since 2010, this has shifted and several hundred are now published annually.² In particular, it's the neurosciences that have taken on this field of research, investigating how mindfulness and meditation influence the body and mind. For example, using scientific measurements, brain researchers have proven that meditation trains and changes certain areas of the brain. Yet, while numerous important findings have thus been compiled, many questions remain unanswered. Is it truly possible to grasp the human mind? Is consciousness measurable?

During his world tour in 1974, the well-known Indian teacher, Swami Muktananda (1908-1982) was asked by a brainwave researcher if he, as a Self-realized master would allow his brain waves to be explored. He answered: “[...] that consciousness is too subtle to be captured by a machine. He added that if the researcher wanted to know what a meditator's experience is like, he could come to his laboratory and experience meditation for himself.”³

The documentary *Monks in the Laboratory* by Delphine Morel also points out the difficulty of measuring stages of deep meditation. In order to study very experienced yogis, the scientists in the film had to travel to them – as they had lived for years in complete seclusion, refusing to come to the scientists' laboratories. Thus, the laboratory had to be brought to them, so to speak. These yogis were quite skeptical as to whether the research projects would have any effect; they countered with comments like: “The mind has neither smell nor color, but is simply a space in which different phenomena exist. How will you measure this?”⁴

Yet research has so far succeeded in revealing a great deal about the mind. Here, research on the mind refers to the psyche, to the level of our thinking and feeling – and in connection with this, to our behavior. It's specifically about the effects of mindfulness and meditation on the brain. Modern equipment renders these effects visible. The present text will highlight this field's most current and significant findings, while also addressing the challenges facing mindfulness and meditation research.

The above-mentioned film *Monks in the Laboratory* focuses on an exchange (Mind and Life Dialogues⁵) between the 14th Dalai Lama and scientists from various disciplines (see “Mindfulness and Meditation in the Educational System – a Paradigm Shift?”, p. 17). One topic the dialogue addresses is how to deal with destructive emotions such as suffering, hatred, jealousy, greed and fear. From the perspective of the Mind and Life team, understanding these emotions and exploring them is one of the most important challenges of the 21st century. As the researchers state, a better understanding of both constructive and destructive emotions would be of great benefit to everyone, but also to society and ultimately to humanity as a whole. In order to further explore the topic of destructive emotions, in Dharamsala (India) in the year 2000, a meeting was held in which the Dalai Lama and several monks spent a week engaging in extensive dialogue with Western scientists. These dialogues are recorded in the book: *Destructive Emotions: How Can We Overcome Them? A Scientific Dialogue with the Dalai Lama* written by Daniel Goleman – who is also the author of the book *Emotional Intelligence: Why It Can Matter More Than IQ*, and also brought this expression into mainstream use. The Mind and Life team was able to prove that mindfulness and meditation approaches have demonstrable positive effects in managing emotions. Numerous scientific studies have now been conducted in the laboratories of the Mind and Life researchers. Not only does mindfulness and meditation relax the mind and body, it's also been found to influence and sometimes even restructure areas of the brain.

Scientific findings and Research questions

The above-mentioned findings have significantly contributed to the growing social interest in mindfulness and meditation and their introduction into many other fields of activity. A new branch of research, CONTEMPLATIVE NEUROSCIENCE, has also emerged from the field of neuroscience.⁶ An important component of contemplative neuroscience is NEUROPLASTICITY, which states that “the brain is an organ of ongoing experience. It continues to grow and change and reshape itself across our entire life span in response to experience, right into old age.”⁷

Richard Davidson, one of the pioneers of contemplative neuroscience and an expert in the study of emotion, believes that people could be happier if they gained more control over their minds. According to Davidson, this in-

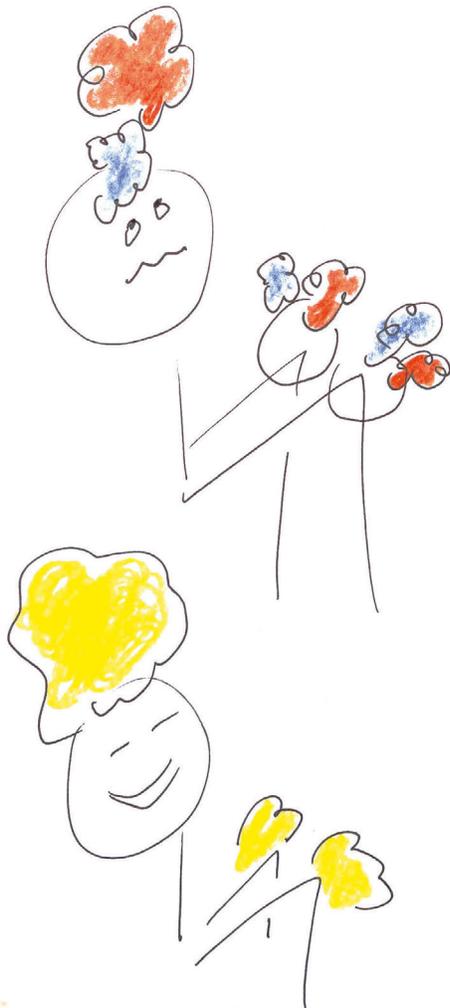
cludes taking more responsibility for one’s own psyche and gaining more insight into one’s own thoughts and feelings.⁸ He points out that mindfulness and meditation practices can make a significant contribution here.

Davidson sees four basic prerequisites for a healthy mind, namely the basic recognition of *awareness*, the *connection to ourselves* and others, i.e. to have emotions such as compassion, kindness, gratitude and thus be able to relate to the environment, thirdly *insight into oneself* and fourthly to recognize one’s *purpose in life* and to orientate one’s behaviour accordingly.⁹ Davidson also names four important building blocks for well-being: *Resilience*, *positive outlook on life*, *attention* and *generosity*.¹⁰

Davidson sees research into the mechanisms of mindfulness and meditation as an important step toward a better understanding of how to cultivate a healthy mind and live a content and fulfilled life.¹¹

To Davidson, the question of what specific effects the practice of meditation has on the brain proves complex. First of all, this depends on the form of meditation, since different approaches usually produce different effects. Davidson also assumes that the effects of the respective meditation forms on the brain are not the same for everyone, since people are different, and therefore respond differently to the various approaches.¹²

Tania Singer – a neuroscientist, psychologist and the scientific director of the Social Neuroscience Research Group in Berlin – has come to the same conclusion. As the initiator and head of the Resource Project, the most comprehensive research project in this field to date, she points out that different mindfulness and meditation exercises produce different findings.¹³ Singer notes the importance of examining these findings – including so-called zero findings in which no effects are observed – in a more differentiated way.¹⁴ It’s important to also take the respective test subject’s constitution into account: “One shouldn’t simply say: in every person who meditates, the immune system is strengthened and aging is slowed down. [...] It also depends on how old or how sick you are.”¹⁵



Worry and negative thoughts also create physical effects; optimism and positive thoughts do as well.

The Resource Project was launched in 2011 and, in addition to attention-based mindfulness, aims to provide new knowledge related to compassion and ethics, as well as greater insight into emotion regulation, stress relief, and mental health.¹⁶ Between June 2013 and November 2014, three-hundred test subjects participated in three training modules, each three months long.¹⁷

The modules focused on the following:

- a presence module: classical attention-based mindfulness exercises
- an affect module: qualities of the heart, but beyond self-care – also gratitude, acceptance, compassion for others and prosocial motivation
- a perspective module: cognitive, sociocognitive. Trains a the bird's-eye view of thoughts, of one's own personality components and of the thoughts and beliefs of others.¹⁸

In the participants of all three modules, initial evaluations have shown visible changes in the plasticity of neuronal networks. Due to extensive and complex data, which includes more than 90 measurement parameters (brain, chromosomes, behavior, etc.), the evaluation of this data continues.¹⁹

To Singer, it's evident that different exercises produce different effects; she compares this with various types of sports that each have specific effects on the body. "But because the mind is hidden inside and not visible like muscles, it's more difficult to understand the complexity and differentiation of our mental functions and to understand that you can cultivate, change and practice them in the same way as you cultivate, change and exercise certain muscle groups through sports."²⁰

As far as practice is concerned, there are still many unanswered questions. It's unclear, for example, whether exercises should take longer, i.e. more than 20 minutes, or whether it is better to offer several short units, i.e. four times five minutes, in order to be effective. As yet, it's assumed that there are no general answers here, but that it varies from person to person.²¹

When considering the effects of mindfulness and meditation techniques, another aspect to take into account is the significance of the order of the exercises, if several are practiced in succession. There's also the question of consequences if exercises are omitted or added.²² Additionally, it's important to consider which type of exercise is appropriate for each situation (see Risks, p. 89 ff.).²³

*This is the experience of everyone
who starts to meditate [...],
that these practices do much more,
that they enrich your life in
an inexplicable way and help you
in things you didn't know
you needed help with before.*

Sara Lazar

Further questions and Challenges

Peter Sedlmeier is a professor of Research Methodology and Evaluation, and the author of a book entitled *Die Kraft der Meditation: Was die Wissenschaft darüber weiß [the Power of Meditation: What Science Knows About It]*. Based on meta-analyses and meta-studies²⁴ as well as an analysis of peer reviewed research,²⁵ he sees the systematic effects of meditation on the brain as being clearly proven, but he is critical of the fact that many studies to date are not based on a well-founded theoretical framework, and are often only retrospectively examined to see which findings might possibly fit the model.²⁶ Sedlmeier points to an important problem confronting research: "What happens in the brain and what can be observed are not however thoughts or feelings, but physiological brain processes that are related to thoughts and feelings in a way that is still largely unexplained."²⁷

In the film *Free the Mind. Can one breath change your thinking?* by Phie Ambo, Richard Davidson reports on a study of meditation novices who meditated regularly over a period of two months. Afterwards, the participants were vaccinated against the flu. In comparison with a control group that also received a flu shot but had not meditated regularly for two months, the meditators were found to respond much better to the flu shot than the control group that had not meditated.²⁸ Despite these positive findings, Davidson admits that research has not yet discovered why this is ultimately the case. For him, a number of questions remain unanswered:

“Is it literally growing new neurons in specific areas that contribute to this? Is it the strengthening of new connections? Is it pruning connections that may have been causing a lot of noise and disruption and it is kind of like a sculptor who takes a block of marble and creates something beautiful by removing components not adding anything? We don’t know what the mechanism is. It could be any one of those mechanisms or it could be all of them.”²⁹

Sara Lazar, neuroscientist in the psychiatric department of Massachusetts General Hospital and lecturer at Harvard University School of Medicine, also sees difficulties in interpreting changes in the GREY MATTER with regard to a precise attribution of causes: “Since we cannot distinguish between these different types of neural changes with the MRI, it is unclear whether the changes we observe in the brain are due to new connections, helper cells or blood vessels. We only know that there are differences in the grey matter.”³⁰

The grey matter of the brain is the area of the brain where the nuclei of the nerve cells are located and where the neurons communicate with each other. According to Lazar, this is where “thinking”³¹ takes place. The WHITE MATTER comprises the parts of the brain consisting of long fibers that connect the different brain regions with each other to ensure the exchange of information.³²

Meditation practices – the “deep” and the “wide” path

In comparing the various meditation practices, Davidson and Goleman have identified two different paths: first there’s the “deep path”, which can be divided into two levels, and second, the “wide path”, which consists of three levels.

The first level of the “deep path”, concerns meditation types in their purest form; they represent the most intensive types of practice (e.g. Theravada-Buddhism). The second level includes those forms that are close to the pure form, but don’t include certain non-transferable intercultural aspects.

On the “wide path”, the first level consists of meditation forms that represent a departure from their original spiritual context and are well suited to the general public (e.g. MBSR). Some examples of second level approaches include special mindfulness and meditation apps for the smartphone, or short exercises practiced at

one’s desk. Apps are currently being developed for even lower-threshold practices, in order to reach more people – and especially the younger generation. These are assigned to the third level of the “wide path”.³³

Deep levels of meditation

Harald Piron, Ph.D., a psychologist and psychotherapist, postulates that a meditator’s experience of consciousness typically exists in relation to a depth dimension³⁴ that correlates to the accumulated previous experience of regular practice.³⁵

He distinguishes five dimensions of depth: obstacles, relaxation and calming, the art of attentional control, essential qualities, and non-duality.³⁶

Referencing Piron’s research on the ranges of meditation depth, the psychologist and neuroscientist, Ulrich Ott, Ph.D., has summarized the five depth ranges as follows:

- “Obstacles: restlessness, boredom, motivation/concentration problems
- Relaxation and calming: well-being, calm breathing, growing patience, calm
- The art of attention control (concentration): awareness, no clinging to thoughts, inner center, energy field, lightness, insights, equanimity, peace
- Essential qualities: clarity, alertness, love, devotion, connectedness, humility, grace, gratitude, self-acceptance
- Non-duality: stillness of thought, oneness, emptiness, boundlessness, transcendence of subject and object.”³⁷

Methods of measurement

Up to this point, Neuroscience in particular has played a leading role in mindfulness and meditation research. There are different scientific methods for this, depending on the effects to be measured. In his book *Meditation für Skeptiker. Ein Neurowissenschaftler erklärt den Weg zum Selbst [Meditation for Skeptics. A neuroscientist Explains the Way to the Self]*, Ott describes these as the measurement of electrical brain activity (EEG) and imaging techniques (i.e. MRI) that reveal where these effects take place in the brain.³⁸

An EEG distinguishes between the following frequency ranges in the brain:

- Delta (0.1 to <4 Hz): dreamless deep sleep phase
- Theta (4 to <8 Hz): drowsiness, light sleep phases
- Alpha (8 to <13 Hz): slight relaxation or relaxed alertness with eyes closed
- Beta (13 to <30 Hz): different causes and meanings
- Gamma (from 30 Hz): during strong concentration, learning processes or meditation³⁹

Summarizing the state of research to date, Sedlmeier observes changes especially in the theta and alpha range as a result of meditation.⁴⁰ He also points to an increase in gamma frequencies: “These effects can be interpreted as signs of increasing relaxation, which is however not (usually) accompanied by increasing drowsiness, but rather by increased attention and concentration.”⁴¹

Although EEG measurements provide valuable information, especially high temporal resolution, this method is not sufficient to determine exactly where changes occurring during mindfulness and meditation practices are located in the brain. Magnetic resonance imaging (MRI) offers a method that allows brain structures, brain functions and brain processes to be displayed and examined in three-dimensional images. The person being examined is placed in a large tube surrounded by a strong magnet; radio waves are used to cause the hydrogen nuclei in the tissue to align themselves briefly against the magnetic field; when they fold back into their original alignment, the absorbed energy is then emitted as a radio signal. This makes it possible to visualize the various changes in tissue and blood flow in the brain, for example when the person switches between tasks. Functional MRI images (fMRI) provide information about real-time changes in blood flow through the regions of the brain. Structural

MRI images show the amount of gray and white matter in the various regions of the brain.⁴² A comparison between MRI images taken before a person had learned meditation and MRI images taken after only a few weeks of meditation practice reveals the changes in the brain caused by meditation.⁴³

Research results

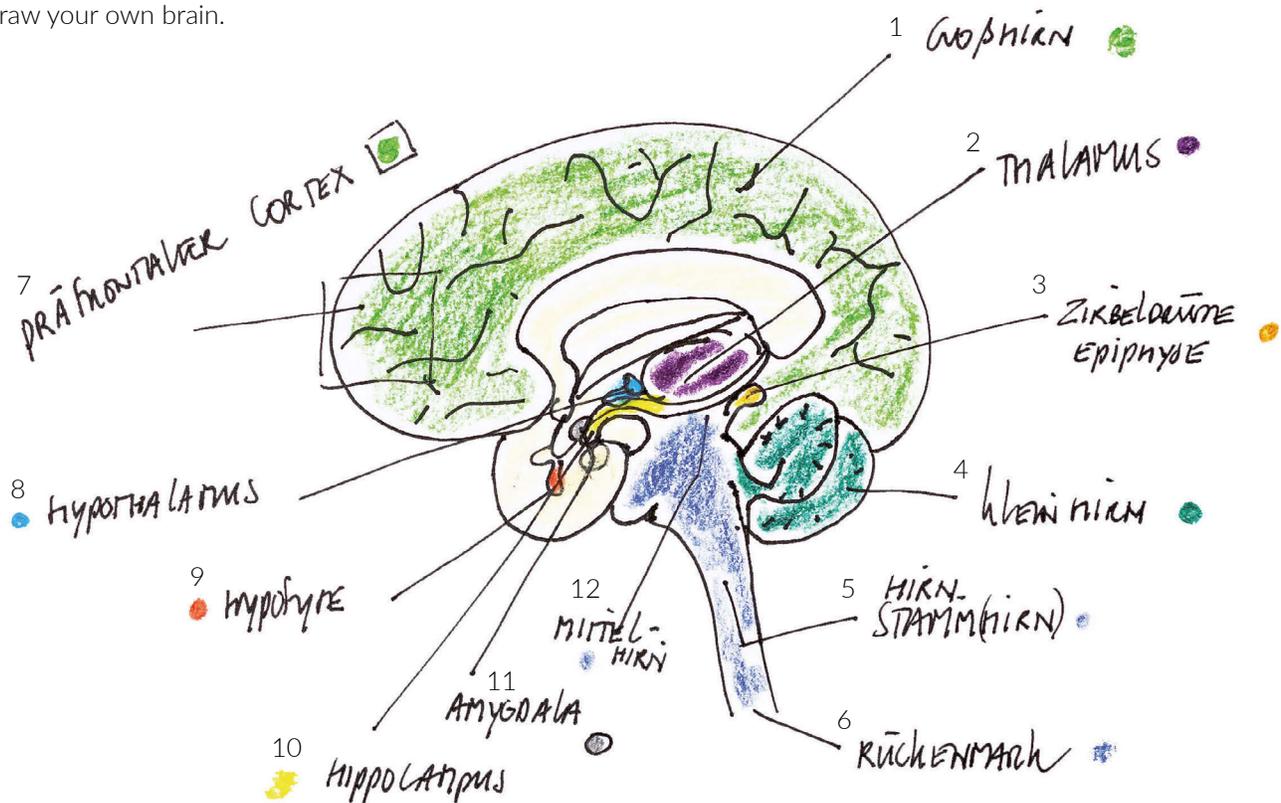
An important result of mindfulness and meditation research as a whole is that mindfulness and meditation have demonstrable positive effects on our attitudes and behavior – and that this can in principle be achieved by anyone. As the monk and scientist Matthieu Ricard emphasizes in the film *The Altruism Revolution*: “My brain is absolutely not special and that comforts me. All this research would not be interesting if it was about studying extraordinary people like those who can hold their breath under water for 11 minutes. What fascinated me most about this research was the length of time people from the Himalayas, Tibet, Bhutan as well as the English, French, Americans, men and women, monks and nuns, lay people spend meditating. This is what makes the difference.”⁴⁴

Apart from the fact that in principle mindfulness and meditation can have a positive effect on all people, it’s also remarkable how quickly one sees initial results. For example, Davidson points out that changes in the brain can already be seen in normal people who practice mindfulness and meditation exercises for 30 minutes a day for only two weeks.⁴⁵

Sara Lazar’s research is dedicated to the question of how the practice of meditation affects the brain and how these changes can lead to lasting positive benefits. She defines behavior as an action of both the body and the mind. According to Lazar, behavior is related to brain activity, which in turn is related to the structure of the brain. She explains that in order for people to permanently change their behavior a corresponding restructuring of the brain structure is required.⁴⁶ Lazar describes the brain structure as “everything that has to do with the way neurons communicate with each other, from the number of connections between neurons to the amount of neurotransmitters that are released at the connection points (synapses)”⁴⁷

In her article, “Mechanismen der Achtsamkeit. Psychologisch-neurowissenschaftliche Perspektiven” [Mechanisms of Mindfulness. Psychological-neuroscientific Per-

Draw your own brain.



¹ cerebrum | ² thalamus | ³ pineal gland | ⁴ cerebellum | ⁵ brainstem | ⁶ spinal cord | ⁷ prefrontal cortex | ⁸ hypothalamus | ⁹ hypophysis | ¹⁰ hippocampus | ¹¹ amygdala | ¹² midbrain

spectives], psychologist Britta Hölzel, Ph.D., – who has carried out research projects on “Mindfulness and Meditation” at Harvard Medical School in Boston, the Bender Institute of Neuroimaging in Giessen and the Charité in Berlin – identifies three different but interrelated areas in which the effects of mindfulness and meditation have so far been proven by scientific findings. Specifically, these are: the regulation of attention, the regulation of emotion, and self-awareness.⁴⁸

Following in particular Richard Davidson, Britta Hölzel, Sara Lazar, and Ulrich Ott, a number of significant research findings are highlighted below.

- default mode network
- “attentional blink” effect
- vigilance, selective and executive attention
- body awareness
- the regulation of emotions
- compassion and altruism
- the dismantling of conditioning
- cell aging

In this context, the regions of the brain that are altered by the practice of mindfulness and meditation will also be examined.⁴⁹

Default mode network

Neuroscientific research has shown that some regions of the brain are more active when test subjects are not performing a task but are at rest. These resting active brain regions are collectively referred to as the DEFAULT MODE network; “This [...] includes regions of the MEDIAL PREFRONTAL CORTEX, the POSTERIOR CINGULATE CORTEX and the PRECUNEUS (regions located on the mid-plane of the brain), as well as the HIPPOCAMPUS located in the TEMPORAL LOBES and also the TEMPOROPARIETAL JUNCTION.”⁵⁰ According to Ott, the activity of the default mode network points to, among other things, so-called MIND-WANDERING, the digression of thoughts: “Whenever we are faced with a situation not requiring us to react or which only calls for routine actions, mental

*The earth would be a different place
if we spent the same amount of time
on caring for our mind as we do
on brushing our teeth.*

Richard Davidson

resources are made available and these can then be used to remember, to reflect, to plan.”⁵¹ Hölzel also sees the function of the default-mode network as an opportunity to reflect on experiences: “Wenn wir uns also überlegen, welche Relevanz bestimmte Ereignisse für uns selbst haben, oder wenn wir uns selbst in einem anderen räumlichen oder zeitlichen Kontext vorstellen – uns also in die Zukunft versetzen oder uns an Vergangenes erinnern –, dann werden diese Vorgänge vom Default- Mode-Netzwerk ermöglicht.”⁵²

As the whole psyche is involved in mind wandering, it's not merely thoughts that are activated, but also feelings. In the case of stressful thoughts and feelings, these have a negative effect on our mental hygiene. An active default mode network also results in reduced attention on the present action and indicates that one is therefore not really present in the moment. The researchers Matthew A. Killingsworth and Daniel T. Gilbert point out that people often find it difficult to be fully aware of what they are doing. In their study “A Wandering Mind Is an Unhappy Mind”, they found that on average,⁴⁷ percent of the people surveyed were not mentally present in the moment.⁵³ Davidson emphasizes that it's both possible and important to reduce this attention deficit; in his opinion, mindfulness and meditation exercises in particular can contribute to this. By merely observing and not evaluating, one learns not to pursue emerging thoughts about the past and future. A conscious presence in the here and now also ensures a reduction in the occurrence of thoughts.⁵⁴

Research has shown that the activity of the default mode network is altered in meditators. From this, researchers conclude that people who practice mindfulness and meditation are generally less distracted by thoughts and are also less preoccupied with themselves. In this context, Hölzel points to a change of meditators' SELF EXPERIENCE:

“We identify less rigidly with ourselves and the things in our lives – with our possessions, our appearance, but also with thoughts, feelings, our personality, habits and idiosyncrasies. Whereas before there was a firm identification with a personality, there is now a feeling that as human beings we are all connected with each other – with a greater whole.”⁵⁵ Through the role of observer and non-attachment as well as a stronger connection with one's own being, there is the TRUST and SERENITY to encounter the world. Research has demonstrated that meditation has positive effects on, among other things, SELF PERCEPTION, SELF APPRECIATION, and SELF EFFICACY, as well as on SELF IMAGE in general.⁵⁶

Blinking of attention (“Attentional Blink effect”)

The ATTENTIONAL BLINKING EFFECT, also known as “Attentional Blinking”⁵⁷, can be used to test for potential changes in the area of attention. It refers to the phenomenon whereby, during the processing of a specific stimulus, no additional stimuli is able to be processed. This short-term “blind spot” (attention deficit) in perception ensures that we miss a subsequent stimulus if it occurs too quickly following the first stimulus or if the first stimulus demands too much attention.⁵⁸ Studies show that meditation practice leads to more efficient processing of the first stimulus, so that the brain is ready in time to grasp the subsequent stimulus.⁵⁹

An increased recognition rate would, for example, also be very valuable in the perception of facial expressions.⁶⁰ It's especially fleeting facial expressions, the so-called *micro-expressions*, that say a great deal about people because they show feelings in a completely uncensored way. Though these are not easy to perceive, one can learn this with training. In a study of experienced meditators, the recognition rate of emotional expressions was found to be comparatively better than that of test persons without meditation experience.⁶¹

Vigilance, selective and executive attention

Hölzel identifies changes in three areas of attention due to mindfulness and meditation practices: VIGILANCE, SELECTIVE ATTENTION and EXECUTIVE ATTENTION.

Vigilance, a long-lasting attention, “refers to the willingness to respond appropriately to rare stimuli in monotonous and long-lasting situations.”⁶² Selective attention “refers to the selection of specific information from a variety of information. It is the selection of the object or thought process to which the attention is directed.”⁶³

Executive attention “refers to the monitoring and resolution of conflicts of attention through distracting stimuli. This means consciously turning to a stimulus, even if it means that other things must be ignored.”⁶⁴

According to Hölzel, studies show that selective and executive attention can be quickly improved by mindfulness and meditation exercises, whereas a positive effect on vigilance requires long practical experience.⁶⁵ She refers to the so-called ANTERIOR CINGULAR CORTEX (ACC) as a brain region that is clearly involved in regulating executive attention. Here, studies have shown changes in both the GREY MATTER (thicker cortex) and the WHITE MATTER (increased integrity of connecting fibers) as effects of mindfulness and meditation.⁶⁶

Body awareness

Awareness of our body enables us to recognize sensations in the body. Mindfulness and insight meditation techniques use these sensations as an object of focus and strengthen the connection between body and mind. An important exercise in this regard is the body scan (see p. 135 ff.). Studies show that such techniques lead to a change in the anterior INSULAR CORTEX of the RIGHT HEMISPHERE of the brain. Lazar points in this regard to an increase in the density of the GREY MATTER.⁶⁷

Emotional regulation means: not being the pawn of your own emotions and being able to observe them from outside oneself. We are not our emotions!

According to Ott, this region of the brain makes it possible to create a so-called “METAREPRESENTATION of the PERCEIVED BODY”⁶⁸, since here a great deal of information from inside the body comes together. In addition to body sensations, it’s where individual emotional states are registered.⁶⁹ An improved awareness of one’s body also has a positive effect on our thinking and on the decisions we make.⁷⁰ Increased awareness of our own emotional world us to put ourselves in the shoes of others. Hölzel points out that the practice of mindfulness and meditation has a positive influence not only on EMPATHY, but also on AFFECT REGULATION, in particular registering and appropriately reacting to one’s own feelings.⁷¹



Emotion regulation

To be aware of our emotions, yet not controlled by them, allows us more room to maneuver and to react appropriately in specific situations. Research has shown that the practice of mindfulness and meditation has a positive effect on the REGULATION of EMOTION. It has also been shown that these reduce the frequency and intensity of negative emotions and amplify positive emotional states.⁷²

Citing the reasons for this shift towards positive emotional states, Hölzel explains that mindfulness and meditation exercises make it easier to reinterpret emotional situations – what's referred to as REAPPRAISAL. The acceptance of a situation, and the withholding of judgement, what's termed NON-APPRAISAL, also leads one to less identify with destructive emotions. In addition, mindfulness and meditation generally improve the capacity to resolve CONDITIONING. This also supports the modulation of emotional reactions.⁷³

As the PREFRONTAL CORTEX controls attention, it also is vital to the control of emotions.⁷⁴ Among other things, it has a regulating effect on limbic regions such as the AMYGDALA. This area in the brain is activated when we are confronted with fear-inducing stimuli.⁷⁵ One part of the amygdala is important for recognizing signs of danger. Once these are recognized, another part of the amygdala then triggers a cascade of reactions. According to Davidson, this cascade consists of three central components: “One is the behavioral component, which may be associated with freezing or with running away, with fleeing. It could include the second component, that is the second component, which will involve changes for example in heart rate and blood pressure to prepare the organism to act. And the third component is changes in hormones. And the key hormone here is CORTISOL, which is a stress hormone.”⁷⁶

Studies have shown that the practice of mindfulness and meditation leads to a reduction in the activity of the amygdala.⁷⁷ This also affects the HIPPOCAMPUS – a part of the brain important for the regulation of emotions and, which among other activities, ensures that one is able to react to situations in an emotionally appropriate manner. If the activity of the hippocampus is weakened, we find our ability to control this much more difficult.⁷⁸ The cells in the hippocampus are damaged by cortisol. If the cortisol level is elevated for a longer period of time in the case of prolonged stress, this has a damaging effect on the hippocampus and its functions. A decrease in gray

matter is visible in this area of the brain. Studies have shown that mindfulness and meditation reduce stress and thus, among other things, the activity of the amygdala. The decrease in cortisol levels has a positive effect on the hippocampus and is reflected, among other things, in an increase in gray matter in this area.⁷⁹

Compassion and Altruism

If meditation techniques are combined with the practice of empathy and compassion – generally referred to as metta meditation forms or meditations of loving kindness – the intensification of compassion and altruistic behavior is an observable effect.⁸⁰ In the book *Caring Economics*, by Tania Singer and Matthieu Ricard, several authors report on the innate nature of compassion and why we should encourage this ability, instead of individualism and competition.⁸¹ In their book *The Emotional Life of Your Brain* Davidson and Begley write on how the structure of the brain determines our emotions, and how we can influence them. This is noted in research in which participants, after training in metta meditation, were observed to make much more altruistically-influenced decisions in risk simulation games than they had before such training.⁸²

An increase in the number of connections between the affected brain regions generally leads to an improvement in empathy and social intuition.⁸³ In the film *Free the Mind*, Davidson points out that after only three months of practicing compassion meditation, participants were able to perceive their surroundings more subtly and to better judge other people.⁸⁴

Previous studies have shown that people basically have an inherent BASIC INNER GOODNESS.⁸⁵ In order to promote this capacity in children between the ages of four and seven years, Davidson's Center for Healthy Minds has developed a mindfulness-based Kindness Curriculum for the core curriculum.⁸⁶ The exercises teach children, for example, “how to be connected and friendly towards themselves and the people around them.”⁸⁷ Since the brain has a high degree of neuroplasticity at this age, Davidson's team is focusing on this area; it's precisely during this phase that the brain undergoes extensive restructuring and interventions can have a considerable impact.⁸⁸

Conditioning reduction

The practice of mindfulness teaches us to be more in the here and now, to consciously perceive the respective moment and to approach it with curiosity. It's also about observing first instead of immediately judging situations or impulsively reacting to the respective sensory stimuli.⁸⁹ This attitude automatically leads to an open, unbiased basic attitude in life and to more serenity and acceptance. Forms of mindfulness and insight meditation also make it possible to re-examine and, if desired, to change AUTOMATIC PATTERNS OF ACCEPTANCE, THINKING and BEHAVIOUR. Situations can be constructively reinterpreted and thus avoidance strategies can be reduced. Meditations of deep contemplation, which are aimed at a comprehensive inner silence, even lead to a general lessening of CONDITIONING (see "Mindfulness and Meditation in the Educational System – a Paradigm Shift?", p. 20).

The ventromedial prefrontal cortex, the amygdala and the hippocampus are particularly important for the reduction of conditioning and the relearning of emotional responses. As mentioned above, these brain regions can be positively altered through mindfulness and meditation practice.⁹⁰

Cell aging

EPIGENETICS, a field of biology that deals with the mechanisms of gene regulation and its inheritance, has recently also begun to study the effects of mindfulness and meditation interventions on our chromosomes.

The length of the TELOMERES, the protective caps of our chromosomes, is reduced during cell division. If the cell continues to divide, at some point the cells have no more protection and therefore die.⁹¹

Elizabeth Blackburn, a molecular biologist and Nobel Laureate in Physiology/Medicine, has shown that stress accelerates this shortening process. Conversely, a reduction in stress, but also merely a constructive approach to stress, has the potential to counteract such degeneration. Initial studies have shown that mindfulness and meditation exercises increase the concentration of TELOMERASE, an enzyme responsible for the production of telomeres. This regenerates the telomeres and slows down the processes of degeneration.⁹² It has not yet

been determined how long the increase in telomerase values lasts. It is hoped that further studies will provide more information about this.

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- ² See "Mindfulness Journal Publications by Year, 1980-2015", in: American Mindfulness Research Association (2016): goAMRA.org. See also Sedlmeier 2016, p. 59 f.; Hölzel / Brähler 2015, p. 9; Ott 2015, p. 167 f.
- ³ Muktananda 1999, p. xx.
- ⁴ Morel 2016, 17:51 min.
- ⁵ Further information: www.mindandlife.org; see also Goleman 2004, p. xiii ff. and the film Dalai Lama – Scientist (2019) by Dawn Gifford Engle.
- ⁶ Cf. Kabat-Zinn 2013, p. 219 f.
- ⁷ Kabat-Zinn 2013, p. 219.
- ⁸ With regard to taking responsibility for our mind, see also Singer / Ricard 2017, p. 177 ff.; as well as Gilman / Lestrade 2016, 51:55-52:22 min.
- ⁹ Cf. Davidson 2018, p. 61; see also Davidson's TED lecture (2019b) "How mindfulness changes the emotional life of our brains", www.youtube.com/watch?v=7CBfCW67xT8 (accessed September 13, 2020); and lecture and panel discussion "We can change the brain, by changing the mind" on March 19, 2019a, Professor Richard Davidson in Munich at the Forum für den Wandel of the Edith-Haberland-Wagner Foundation, www.ehw-stiftung.de (accessed September 13, 2020).
- ¹⁰ Richard Davidson Lecture (2016) "The Four Constituents of Well-Being", www.youtube.com/watch?v=HeBpsifQITI (accessed September 13, 2020).
- ¹¹ The Center for Healthy Minds, founded by Richard Davidson, conducts a great deal of research in this area. Further information: www.centerhealthyminds.org (accessed September 13, 2020).
- ¹² Cf. Davidson 2018, p. 58; see Ott 2015, p. 167.
- ¹³ Cf. Singer 2019a, p. 60 f.
- ¹⁴ Cf. Singer 2019a, p. 64.
- ¹⁵ Singer 2019a, p. 64 [Author's translation].
- ¹⁶ Cf. Singer 2018, p. 63 ff.
- ¹⁷ The Free E-Book *Mitgeföhl. In Alltag und Forschung* by Tania Singer and Matthias Bolz describes training programs, the current state of science and reports on practical experience: www.compassion-training.org/?lang=de.
- ¹⁸ Cf. Singer 2019a, p. 58 ff.; see also Singer 2018, p. 63 ff.
- ¹⁹ Cf. Singer 2019a, p. 63 f.
- ²⁰ Singer 2019a, p. 63 [Author's translation].
- ²¹ Cf. Davidson / Goleman 2017, p. 276.
- ²² Cf. Sedlmeier 2016, p. 168 f.
- ²³ Cf. Sedlmeier 2016, p. 169 f.; see also Singer 2019a, p. 61 f.
- ²⁴ Cf. Sedlmeier 2016, pp. 74 ff.
- ²⁵ Cf. Sedlmeier 2016, p. 80 ff.
- ²⁶ Cf. Sedlmeier 2016, p. 172.
- ²⁷ Sedlmeier 2016, p. 103 [Author's translation].
- ²⁸ Cf. Ambo 2013, 1.04:10–1.04:43 Min.
- ²⁹ Ambo 2013, 1.04:44–1.05:22 min.
- ³⁰ Lazar 2015, p. 79 [Author's translation]; see also Hölzel 2015, p. 70.
- ³¹ Lazar 2015, p. 74 [Author's translation].
- ³² Cf. Lazar 2015, p. 74.
- ³³ Cf. Davidson / Goleman 2017, p. 3 ff.
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- ³⁷ Ott 2015, p. 17 [Author's translation].
- ³⁸ Cf. Ott 2015, p. 173.
- ³⁹ Cf. Ott 2015, p. 169 f.; see also Sedlmeier 2016, p. 104 ff. and Singer / Ricard 2008, p. 67 ff. and p. 116 f.
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- ⁴¹ Sedlmeier 2016, p. 109 [Author's translation].
- ⁴² Cf. Lazar 2015, p. 73.
- ⁴³ For a description of the two methods see Ott 2015, p. 167 ff.; see also Sedlmeier 2016, p. 104 ff.
- ⁴⁴ Gilman / Lestrade 2016, 49:12-49:52 min.
- ⁴⁵ Cf. Gilman / Lestrade 2016, 50:12-50:24 min.
- ⁴⁶ Cf. Lazar 2015, p. 71 f.; see also Lazar, Sara (2011). "How Meditation Can Reshape Our Brains: Sara Lazar at TEDxCambridge", www.youtube.com/watch?v=m8rRzTrP7Tc, 0:13-8:33 min. (accessed September 13, 2020).
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- ⁴⁸ Cf. Hölzel 2015, p. 43 f.
- ⁴⁹ In the book *The Neuroscience of Mindfulness Meditation. How the Body and Mind Work Together to Change Our Behavior* by Yi-Yuan Tang, the neuroscientific findings as well as the specific brain regions affected are explained. Also included is a glossary with an explanation of many brain regions, see Tang 2017, p. 11 ff. For an overview of which brain changes caused by mindfulness and meditation exercises have thus far been scientifically proven, see also Ott 2015, p. 178 f.
- ⁵⁰ Hölzel 2015, S. 68 [Author's translation]; see Buckner / Andrews-Hanna / Schacter (2008) as well as Siegel 2018, 135 ff.
- ⁵¹ Ott 2015, p. 98 f. [Author's translation].
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- ⁵³ Killingsworth, Matthew A. / Gilbert, Daniel T. (2010). *A Wandering Mind Is an Unhappy Mind*, [www.danielgilbert.com/KILLINGSWORTH%20&%20GILBERT%20\(2010\).pdf](https://www.danielgilbert.com/KILLINGSWORTH%20&%20GILBERT%20(2010).pdf) (accessed September 13, 2020).
- ⁵⁴ Cf. Ott 2015, p. 98 ff.
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- ⁵⁶ Cf. Hölzel 2015, p. 43 f. and p. 67.
- ⁵⁷ In the case of Singer / Ricard 2008, p. 66: "Blinzeln der Aufmerksamkeit" [*Blinking of Attention*], Author's translation].
- ⁵⁸ Cf. Slagter / Lutz / Greischar / Francis / Nieuwenhuis / Davis / Davidson 2007; see also Singer / Ricard 2008, p. 66 ff. and Hölzel 2015.
- ⁵⁹ Cf. Slagter / Lutz / Greischar / Francis / Nieuwenhuis / Davis / Davidson 2007; Singer / Ricard 2008, p. 66 ff.; see also Hölzel 2015, p. 49 f. and Ott 2015, p. 102.
- ⁶⁰ On the perception of facial expressions, see the lecture "The Universality of Emotion" by Paul Ekman, Professor of Psychology and Director of the Human Interaction Laboratory at the Medical School of the University of California at Goleman 2004, p. 119 ff.
- ⁶¹ Cf. Singer / Ricard 2008, p. 73 f.
- ⁶² Hölzel 2015, p. 47 f. [Author's translation].
- ⁶³ Hölzel 2015, p. 47 [Author's translation]; see also Morel 2016, 4:07–5:38 Min.
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- ⁷⁰ Cf. Ott 2015, p. 65 ff.; see also Sedlmeier 2016, p. 66 f.
- ⁷¹ Cf. Hölzel 2015, p. 63 f.
- ⁷² Cf. Hölzel 2015, p. 50.
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⁷⁴ Cf. Ambo 2013, 1.03:28-1.04:10 min.

⁷⁵ Cf. Hölzel 2015, p. 53; see also Lazar 2015, p. 74; Ott 2015, p. 70 ff. and p. 180.

⁷⁶ Ambo 2013, 37:54-38:41 min.

⁷⁷ Cf. also the contribution in Bayern 2 by the moderator Birgit Magiera "Achtsamkeitsforschung – Frieden für die Welt oder Wellness fürs Ich?" (Mindfulness research – peace for the world or wellness for the self?) on 5 March, 2020, <https://www.br.de/mediathek/podcast/iq-wissenschaft-und-forschung/achtsamkeitsforschung-frieden-fuer-die-welt-oder-wellness-fuers-ich/1793281>

⁷⁸ Cf. Ambo 2013, 37:22-37:54 min.

⁷⁹ Cf. Hölzel 2015, p. 58 f.; see also Lazar 2015, p. 77 f. and Ott 2015, p. 71 f. and p. 178.

⁸⁰ Cf. Ambo 2013, 12:25-14:15 min; see also Ricard 2016.

⁸¹ See Singer / Ricard 2015.

⁸² Cf. Davidson / Begley 2013, p. 222 f.; see Sedlmeier 2016, p. 67 f.

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⁸⁷ Davidson 2019c, p. 50 [Author's translation].

⁸⁸ Cf. Davidson 2019c, p. 50; see also Gilman / Lestrade 2016, 52:25-56:08 min.

⁸⁹ Cf. Kabat-Zinn 2013, p. 19 ff.

⁹⁰ Cf. Hölzel 2015, p. 58 f.

⁹¹ Cf. Kabat-Zinn 2013, p. 220 f.

⁹² Cf. Blackburn / Epel 2018, p. 12 and p. 153 ff.; see also Kabat-Zinn 2013, p. 220 f. and Davidson / Goleman 2017, p. 177.

